Notebook Series -- Notebooks by Edison
Notebook, N-17-06-28

This notebook is a continuation of N-17-06-14.1. It was used by Edison in June-July 1917 to record research on amplification for the U.S. Navy during World War I. This work was probably done in connection with Edison's attempts at aiding submarine detection. There is also one entry by Jerry T. Chesler. Included are diagrams and descriptions of experimental amplifiers for detecting sound, along with notes regarding their performance. The components involved include audions, induction coils, batteries, condensers, phonoplexes, and mirror galvanometers. Some entries refer to work in earlier books in the series. A final entry summarizes the best amplifiers using one and two audions and concludes "Now for a good Carbon Telefone." The experiments are continued in N-17-00-00.8 The front cover is labeled "U4." The book contains 100 numbered pages; pages 94-100 are blank.

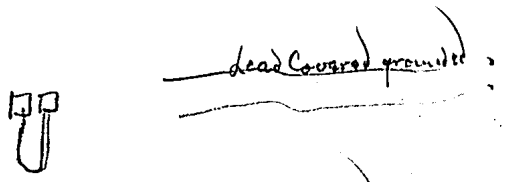
17-0

Thursday 28th 1917

We now go back to our Reg Series plan—

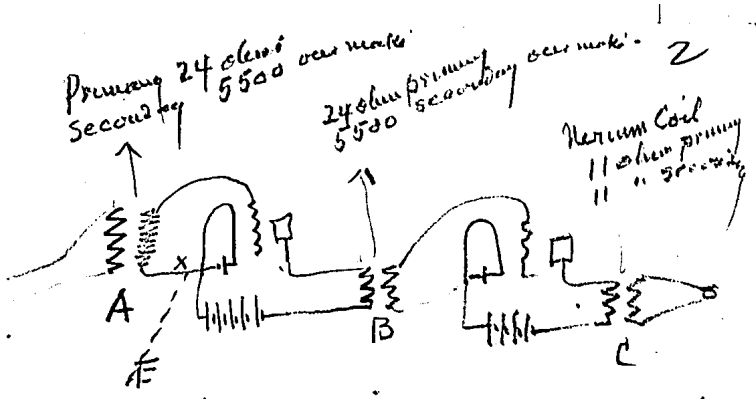
& try out the new input Coil furnished by the American Transformer Co

The Output Coil is a failure



phonoplex 6 Waves second

phonoplex secondary 2 coils
Each 2500 ohms each
but Multiple Res 1250



3 bulbs in Multiple arc on each audion

Transformer A B + C in iron boxes

Audion bulbs in Iron boxes

5 cell filament batteries in iron boxes —

130 Cells Storage Battery on Each audion —

battery boxes set on glass Insulators

All iron boxes on glass insulators.

Note

3

all leads twisted & covered with lead. Each lead sheath grounded

One general ground at X -

Phonoplex 2" away, gives 8" stimulus which throbs to 10 @ 11 —

Zero - 25% Zero 50% 1½ @ 2"

25 2 to 4" with an occasional jerk to 8" but not often -

Zero too unstandy to go to 2½" for phonoplex yet expert could detect 6 vibs -

As degree of amplification
Comes down the Zero
gets more steady —
with 4" amplification
instead of 8" the Zero
is OK keeps 50% Zero + 50%
within 1" —

The thing to work on
is a better phonoplex
+ Absolute Insulation
of the system — if system
had a Constant insulation
resistance between all
of 10 megohms Zero would
be Constant

The Mirror works perfectly — have worked with one mirror 2 weeks without it once getting out of one tooth of requiring any adjustment During all this time we have used a phonograph kept wound by a motor giving 6 revolutions per second, the milliamp on directing mag always in the same when in tune, (ie) Keep Mil amp Constant & Tuning never changes —

The arm of phono has 1 bell

Amplification is demonstrated by demonstrating Cells on grid plate & Zero is more steady –

If amplification is too great Can shunt Mirror opposed or demonstrate battery on grid plates

Insulation Can be improved by use of pure rubber or gutta percha covered leads if necessary

diaphragm only

American Transformer Co

Input Coil –

Primary 5 Coils 2.51 ohm Each – Total 12.56 ohms
Total Turns 1050

Secondary

14 Coils – Each 1600 ohms
total 22400 ohms
Volcanite Series –
40 To 1 Total turns 42000

This dont give us any chance to make many changes on primary but does on secondary

	Rev Sec	3 Sounds
80 Rev Screw propellor	1.33	3.99
90	1.55	4.5
100	1.66	4.98
125	2.09	6.27
150	2.5	7.5
200	3.3	9.9
250	4.1	12.3
300	5.	15
350	5.83	17.49

We are OK on present mirror galv if Each paddle gives a Sound

But if only 1 Sound per revolution Then 200 Rev min is lowest we can work present mirror to go to 1.33 per second must make an astatic needle mirror galv

Think this Coil is no advantage over ours Except better insulated

But it lacks in Mass of iron that ours has —

We now Connect up the New Input Coil of the Amen Transformer Co —

gives very bad Zero. from 2 to 10" jerks — but finally settles down to 2" Zero with jerks quite often of 10"

setting phonaplex away $2\frac{1}{2}$" gives good steady throw but less

than $5\frac{1}{2}$ inches - band would be unmistakable from the sea as 6 waves. The throw is steady but shows lots of tight spots.

We now have AmerTCo Input on #1 audion - Ours on input for #2 Audion & Herman for output - ground wire at #1 Audion off - Jumps off scale - put

ground wire on - not quite so bad but perhaps off scale - we also at same time took off each window 1 tray of battery.

As we cant get any test on account of the Zero being bad we will shunt the Mirror face of we can read the phonoplex

(High humidity today 80° Fahrenheit)
High humidity would delaqueuse the KOH on battery boxes which would be dry in low humidity -

100 ohm shunt, bad Zero
2" phonoplex - Cant read

We now keep shunt 100 +
Ret phone 1" away
get good Zero - with
10 ohm shunt around
galvanometer Mirror
phonoplex 1" 12" throw
" at 1½ 2" throw -
with a four Zero 80%
Zero, now also then 1½" jump -

Now 10 ohm shunt
phonoplex 2" - Cant be
over as it sometimes
Comes to Zero at most is
not over 1" The bell
phone is in ckt with

Mirror + shunt around ~~[illegible]~~ mirror

LOE now put shunt of 10 ohm around mirror

~~only [illegible] phone~~

~~[illegible]~~ +

phone — not so good as around the mirror only — Cant be sure of $1\frac{1}{2}$ phonoplex — get 2 @ $2\frac{1}{2}$ steady this would be OK —

phonoplex $1\frac{1}{2}$ pair zero + 4" swing good + steady.

We now put a Mica Dia on the lever worked by the arm of Disc phonograph. by shifting the mirror wide 25 to 50 ohms to get a zero that we can work with. (Zero now gets all over whole scale)
We put a reg bell longphone in front of lever with Mica & can get off scale at 3" at 6" to 10 to 12" & at one for 3 or 4" but

When we oil the wheel
it goes way down to
almost nothing and
6" away showing
the 6 vibrations are
due to knock of
Roller on Cam wheel
I have always been
doubtful of vibration
of 6 per sec. went into
air as a sound
wave, I think it
don't & this helps

to confirm it - possibly
it may but it is very
weak like a fork
as this cant condense
to any extent as it
goes around the thin
disk -

We now put the 1250 ohm
all phonoplex on iron disk
back set at $1\frac{1}{2}$ away
shunted Kenna with
50 ohm to get a
zero workable - get
5" deflection -

Now we now demonstrate resistance on filament battery of Each revolution 5 Convolutions of Spiral on ~~[illegible]~~ Res -

About the same or 5" swing -

Made 5 more moves on Resistance - $2\frac{1}{2}$ @ 3" swing

Made 5 more moves - gives $2\frac{1}{2}$ deflection.

Made 5 more moves - give 2" swing - Yellow red

Now we put it back to original & Cut out 5 convolutions - bright yellow red - swings 6"

We try 5 more Res convolutions 6" or shade less - full battery on - no gain

We now remove 1/2 of the grid battery on each audion to see what it does — (Minus cells)

get 2"

For last 2 weeks we have been using —

U18 — Mirror —

We now put in

U14 6/32 length

fibre 10 needles

NG Cant get Zero with Scotch effect

We put in U6 2 needles
This is very sensitive to jiggle

Note = Evidently
U18 is unique in being
insensitive to shock —
We shall probably have
to make many duplicates
to get good ones.
Cant do anything
with U6 —

We put in U5
2 double length needles
Jumps tremendous

U19 in now, fibers absorbed
with 1 gram 5 needles –
turning 37 Melang

U24 is nearly as steady
turning 26.1 about – light too
big = + at angle

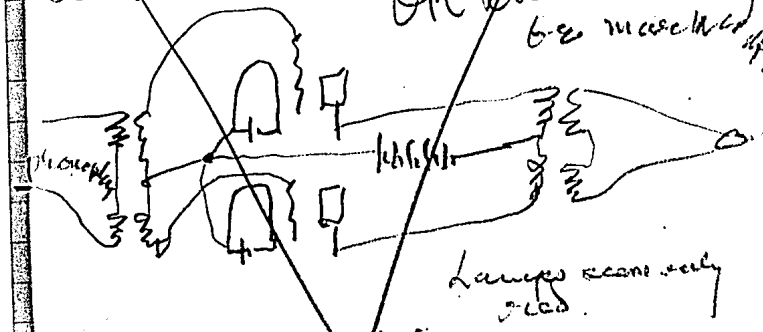
U25 –
turning 32.8 about
steady like U18
good light –

U26 – light big
pretty steady not as good as U18
turning 37.4 about

U27 = dight large round
U18 very steady – as good as
Turning 60 – not very
sensitive find out what
difference is between
this & the others NG
as compared

0 04

We now try an Experiment to get both sides of the wave. OK should not be marked off



$1\frac{1}{2}$" phonograph
1 6 x Clamp –
50 ohm shunt on
mernoi 1/4" throw
100 ohm shunt 1"
throw 500 ohm"
$2\frac{1}{4}$ throw
loop – 3" throw
nosiment 4" juncopy

should not be marked off 22

2 batteries now put on
Multiple arc.

Marked off by mistake —

Now 2 batteries Multiple
arc

1 1/2" away Thoraplex

50" ohm	shunt		1/2" throw
100 "	"		3/4 "
500 "	"		3 inches "
1000 "			4" "
No shunt			6"

Thoraplex 2" away

1000 ohm shunt 1/2" throw ~~no zeros~~
~~[illegible]~~ but zeros now
often probably 1 1/2 zeros now & then

With a steady Zero the throw at 2" away of Plano plex would certainly Exceed 1" if not more,

This shows both sides of the screen is certainly a great advantage,

As the film battery will cells low use need change for 5 new Cells on each using 3 bulbs on a side

2" phonepex

		Threaded
50 ohm shunt		1/16th inch
100 "	"	1/8 "
500 "	"	3/4" "
1000	"	1 1/2

Open no shunt 1 1/2 inch
a zero reed & then two —
shorting zero to test —
Multiple among battery no advantage

Multiplies 8 to 1 —

instead of 4 1/2 @ 5 to 1
with 1 single audion —
against 1 audion double
reader —

Note — — We replaced B 2

Note

Later - The reason of good Zero is bulbs have very little amplifying power
Sensitivity 20 times less

Indian bulbs for Ray
ones we have been using
at $1\frac{1}{2}$" got $2\frac{1}{2}$ inch throw steady —
at 2" got 1/2 steady
ZERO is fine on these bulbs —

We now put 5 bulbs in each section of 1 audion
It will require considerable filam battery to run these 5 bulbs — it makes the circuit porcelain

Coil so can put in 3 or
4 ft of heavy resistance
wire in battery circuit
supplying film.
Brought Zeeman up so
bright red with Cadmium
down not yellow red
It is 1" throw at 2" phosphor but
its uncertain as I get a
zero often – ~~Think~~
~~3 breaks in better than~~
~~5 of this type of break~~
~~3 [illegible] 5~~
Think 5 better than
3 –

There is some doubt about all these double audion Experiments with B 2 Lamps, & also old Lamps, I found when lower audion double was in & upper audion was working got amplification but when bulbs cut out & lower audion bulbs cut in got nothing & had to put out 1" phonoplex

+ Then it was less than direct,

Both in phenoplex 1" get 5 1/2 throw –

only 1 in. 3 1/2

Old lamps – put in –

phenoplx 1 1/2" No 2 and in 3/4"

No 1 3-3/4 –

Both together – 4"

Coils must be wrong

Reverse

use ~~short~~ No 1 & mirror

pressing as No 2 and don't

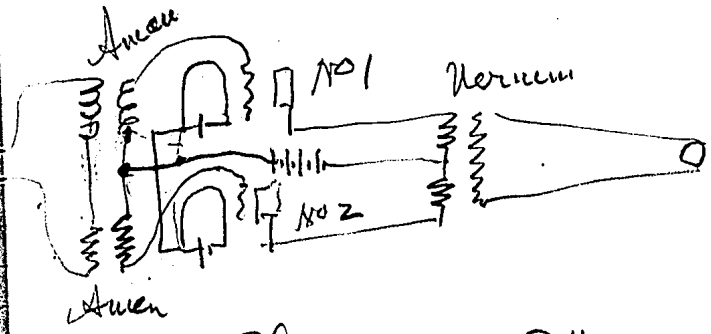
do anything.

Both in Coil put back
4" swing -

We now have received from
Amer Transformer Co another
input coil which is a
duplicate of the first one
got from them -

We put this in place
of ~~the~~ our big one -
using once the Nermum
Coil for output

with the Duplex section



Phonoplex 2" away
This shows a swing of 3/4" on No 1 + 1/2" on No 2 when seperately operated —
No shunt on mirror + very steady Zero, a satisfactory Zero, When No 1 + 2 are operating together we get 3" steady throw

Note

This is high water Mark -
One Audion (Duplex)
3" swing when phonoplex
2" away with a steady
Zero - it seems double so as to move
needle more than a cable

Note that Zero becomes steady
when our coil cut out
& Amen put in place
probably showing less
leakage -

We now add the Amen
Transformer Cos Output
Transfer in place of Merriums

Zero more unsteady - with
2000 ohm shunt on Meter
get 3" throw - at 2" phonoplex

We now disconnect the Duplex
& Connect for 2 separate
Audions in series the
old & Regular way

The Zero is so bad even
with 20 ohm shunt
Cant tell anything
in any event it

dont seem to be any better
at 2" phlomplex than a
single Duplex

We have not got the
2 Input transformers
in iron boxes & they are
only 3 ft apart &
stray lines may be
causing mutual
inductance, We
now move #1 audion
input coil in the
other room - ~~to~~
25 ft away from

#2 Input -

Just as bad a Zero
horrible —

Multiplied are acc
primary Coils in
Output transform
Horrible — big
roar in phone -
2 @ 3 Megohm
Creep leak —

Thursday July 5 —

Test with 1 set of 3 Audion Bulbs to determine best Connection on output transformer All primary coils in multiple all secondary coils in multiple zero quite steady 80% of time almost still rest of time deflections not exceeding one inch..

~~[illegible]~~

Throw at 1½" phonoplex

from 2 to 3 inches
with Primary coils all in series and secondaries all in series zero is 50% of time 1/2" throw 50% between 2 to 4 inches.

Throw with Phonoplex 1½" away 8" to 10" —

with Primary ~~in series~~ Coils all in series and secondary coils all in multiple get zero 80% of time almost still rest

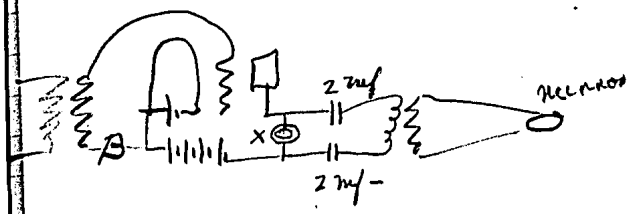
of time deflections not exceeding one inch -
Throw with phonoplex
1½" away 2" to 3"

With Primary Coils all in series and secondary Coils in series multiple Zero.
Zero goes practicaly all the time from ½" to 3½"
Throw with phonoplex
1½" away steady about 4"

With primary Coils all in series multiple and

Secondary coils all in series multiple:
get zero 70 % of time
about 1/2" movement and
rest of time two to 3 inches.
Throw with phonoplex —
1 1/2" away 5 to 8"

A new Experiment



With this set 1" away of phonoplex get steady 9" throw and at 1½ phonoplex away get steady 2" throw — Zero perfect. The idea is to keep current of 100 cell out of coils —

X is a impedence 1800 ohms being secondary of Western Elec phone coil & gives only milliamperes throw to Bulb —

We now increase the the microfarads to 4

Microfarads one side
This increased the throw to
3" but it was a shade
unsteady beat from 2 to
3" but OK —

We now add another
W & Induction Coil
at X to increase
milamperes to the
bulbs from 8 to 16
probably — This dont
increase throw but
actually reduces
it to 2" instead of
3" with one Coil

We note with this arrangement

U25 requires 56 Milamps to tune to phonaplex

Disc running 90 Rev

We now put the 2 Coils in series –

This increased the Wave to 4" but ~~Zero without go~~ The Zero is 0 to 1" –

only 2 mf on each side get 2"

We now now put back make it 4 mf on each Condenser.

gives 2½ about that 4 ant.)

Swells some –

We now put 2 mf at B – (page 39)

gives $3\frac{1}{2}$" Zero is not good goes from 0 to $1\frac{1}{4}$" quite often, + would be better with 2 series conditions - although probably OK for a Duplex circuit We now put 3 Western Elec induction Coils in series at X page 39 making 5400 ohms inductance gives 3½' but still Zero not good enough 0 to 1" Opened Coil circuit X got nothing. —

We now Cut battery from
104 to 52 we get
$3\frac{1}{2}$" —
We now Cut the battery
down to 26 cells.
get $3\frac{1}{2}$ to 4" Zero side
not good 0 to 1"
gives 3" Zero not good
0 to 3/4" —
We now put on 6 cells
only matched of 104 cells
on Reg —
gives 1" Throw —
We now Cut out 1 Coil
of the 3 in at X

still 1" throw —

We now put on One box battery
26 cells — Zero 0 to 3/4"

2 boxes but in multiple —
3/4" throw.

now 3 boxes in multiple
78 cells throw 0 to 1" —

nothing gained here
Dont think battery
has anything to do
with bad zero as far
as bubbles or change of
Rev is concerned.

We now connect all
the batteries 104 together
but Reverse them

putting P to Lamp &
Negative to plate in both
to see if any Current
goes through -
get nothing - Zero
perfect, Then as if
shorted 6 E - We put back
with Regular polarity
Zero is just as good with
104 Cells as with 6 Cells -
This is singular - It
may be the Lamps after all
not the Cells -
possibly fine pieces of
platinum are spilling off
irregularly & Carry heavy

Charges - of Oxide of nickel & metallic nickel -

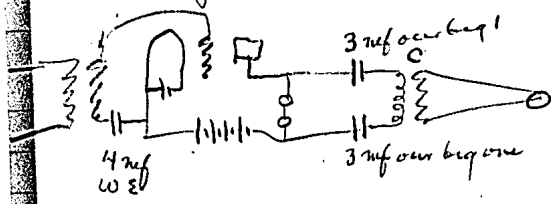
We now with 104 cells on & Condensers of B. 2 mf - & 4 mf each side of primary of Output Coil - take out the W. Electric Condensers & put in One of our old Condensers on Each side, 2.75 @ 3 mf ~~2~~ works about 1 amp

We lowered bulbs by using only 3 cells but only 1/8" throw Phosphor 1 1/2 inch

We now use 4 Cells which is all we have used since page 39 — & make another change — to wit increasing Microfels from 2 to 4 at B (page 39) — Zero 0 to ½ — throw-over 1½" but it zeros now & then. —

Same old trouble with Zero —

We now use one of the Amer T Co input coil instead of their regular output coil to see if we get a better Zero



C is an input coil used instead of their output,

Nothing at 2" phonopler
" 1 1/2 "

We Reverse it & put primary to Mirror & Secondary to Condensors as Secondary is very high Resistance

8" Throw is best, we have got
with 2 series
inductions =

Zero varying from
0 to 1" throw -

Get nothing - ~~Conclusions~~
~~not right.~~ something
must be wrong

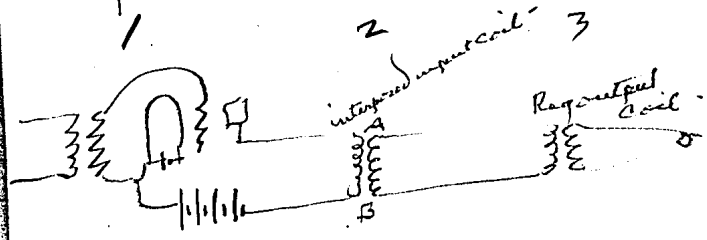
Data of Arcing Transformer

Input Coils 210 turns per coil per coil
~~Secondary~~ 5 Coils in
series No 19 wire -
Secondary 14 Coils. -
3000 turns Each 34 wire

So far we cant get anything through an interposed (Input) Coil as made by ATCo this being so, it seems strange we should get anything when its used as an input Coil for a second induction =

Experiment on page 50 shows its too high in reactance making secondary 1/4 of the reactance gives

We now put the interposed Input Coil in an iron box 1/4" thick



get 1/4 throw —

We now divide the 14 Coils of Secondary of interposed input Coils A B into 2 sections — & multiple are these to bring down the Excessive Reactance —

We get 2" with phonoplex 1 1/2 throw for a input Coil for a Second induction is to high reactance

The iron box we put the AB coil in has stopped entirely the loud vibration we got last night by putting wires at A or B across from secondary to primary -

We now put both input & intermediate coil in iron box 1/4" thick — 1½ phonoplex all coils in 1 2 & 3 2" thick

We now cut ultramedicale Transformer out & have plain induction

No grounds on lead sheaths anywhere – $1\frac{1}{2}$ phosphor

12" throw 2" phosphor 2" @ 3

Zero 0 to $1\frac{1}{2}$"

We now have a magneto & gal made in England for testing in Megohm resistance of insulation & will test our Coils & apparatus

Two poles of tester =

#1 test

1 to ground Jerry's body to dry floor 5 @ 7½ Megohms

Harlan 2½ "

Burns 4 "

#2 both primary & secondary.

Output Coils to tester, 1 gale

Iron Core — 2nd "

tested twisted rubber covered cord leading to Transformer before connecting to it — got Nothing by tester

Now Connected — using a seperate cord one for Core & one for each coil on transformer —

Instrument shows nothing (R) in excess of 40 megohms marked infinite —

Now Perry puts a telephone in circuit with the Tesla, & coils.

Perry hears at a strong, hears hum of Magnets ~~[illegible]~~ ~~[illegible]~~ & some slower ~~[illegible]~~ all seen about 30 to 150 etc

We separate Coils —

Put primary Coil & frame together thru Tesla, same thing, ~~[illegible]~~ Crackers in telephone

Now put secondary to frame & Tesla same thing —

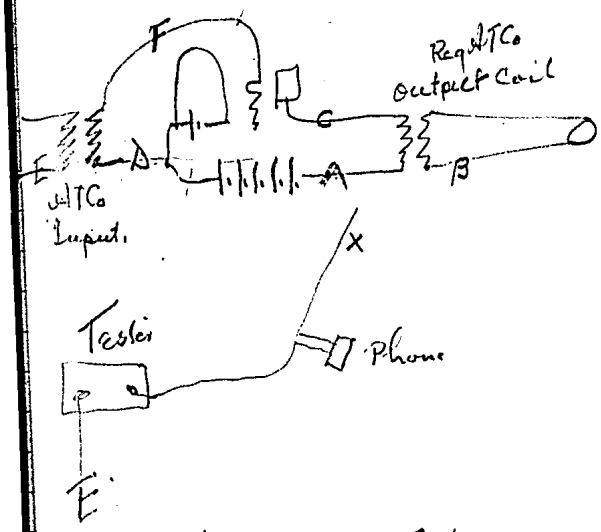
Disconnected 1 end of telephone, Hum much

weaker [redacted] + a Coil Vibrating almost gone -

We now try the Maximum -
Spools or Coils - [redacted]
just over the magnetic -
~~Between~~ between the 2 sets of Coils, infinity -

Output Transformer between the 2 Coils - just below infinity

Both Input Transformers are about the same - just near infinity



We test A B C D E by putting wire X at these points.

Before starting we test system 1½" phonoplex throw is. 10" Zero 0 to 1¼" –

Now X wire put at A. phonoplex Receiving – Zero 0 to 2" get the hums a occasionally a click from arm of needle. goes acc acc. ATC

Scale showing spots
Hum is there for the Spits –
he hears plainly & its those
spits that worries the needle
violently –

Now at B, get some Spits –
needle goes 10 @ 15 – Can't show
show so many spots & not
so violently agitated –

Now at C needle nearly
with 6" shows spots, Jim
says phone not so strong
for Spits –

Now D needle wore off
scale, spots darker for
days - great many more
spots & louder

Now E needle at 1st went
clear off then scaled
down to 6" scaling
spots not frequent off
for days at 1st
sound very powerful
spots, then weaker
like previous tests,

Now at F needle off scale all the time - Jerry says strong spots, comes in lots of 3... 50- per min

This all seems to prove that the trouble is the Bulb, That particles jump over carrying heavier charges than the Electrons

Ringing tester between grid & plate - gave as low as 8 megohms when taken out of socket the socket was infinite - therefore the

the lamp filament is not lighted but cold — all these [illegible] are away from audion —
Another lamp gave infinite —

The one that gives 8 meg has one of the wires broken on the grid, —

Tried one of the V lamps has resistance over 40 meg ohms —

We now take battery off the 3 regular Audion bulbs & test resistance of the 3 in parallel

the test is (old) filament
Its just below infinity
Henry dont hear anything
Except 60 cy hum

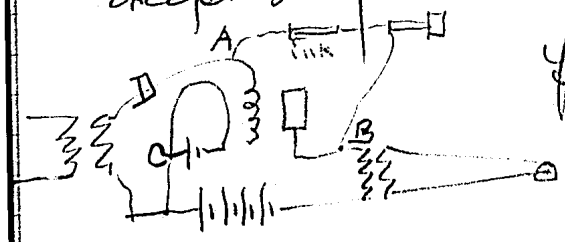
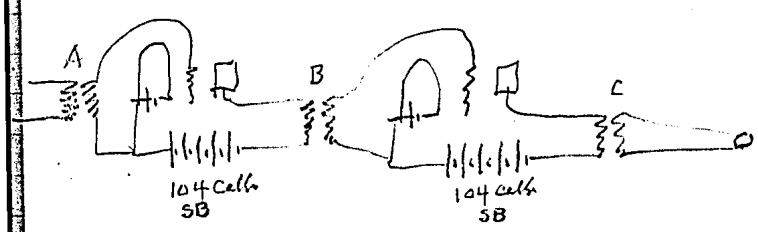


fig 2

We now without Megger put a shunt around at A + B fig-2 - with a Megohm in Indica Link Pier + listen - Whistles - no spits - The shunt demonstrates amplifying powers from 10 to 1/2 " fault check now when this shunt needle

fig 2 LOE was connected
Ohmit as C.D -
amplifying power 7 @ 8" as argument
10. 1½ phonoplex -
heard nothing on phone -



A Reg ATC input
B " " but 7 secondary coils
multiplied with 7 coils making
1/4 of Reg resistance -
C Reg ATC Output Coil -

This Experiment is to see what

improvement in amplifier, we can get by lowering resistance of the No 2 Input secondary turns which when interpaired in a single section we couldnt get anything but which when 7x7 coils multiplied gave fair amplification —

Cant get a zero, vibrates very bad even when switch open at mirror. We grounded lead on mirror line, this stopped it & also stopped shock to fine when one pole of open mirror switch touched

irregular beats of 80 to 100 minutes - which not coincident with needle jump - This all stopped when lead sheath grounded which acted as a condenser Even finger drew bright sparks from open pole of Mirror switch -

grounded iron Transform boxes this made it better, still no mirror stand on scale but jumped bad - Spots - 100 ohm shunt Zero 0 to 1 3/4" - Nothing much Coil may be

Reversed — Phonoplex is 2" away — tried it Very strong high note whistle, throws needle off scale.

We Reverse 5 cell battery on 2 circuits

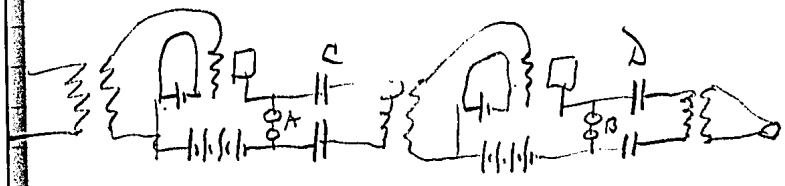
Cant do anything with it no amplification, —

We now test No 1 circuit seperate, then No 2 Seperate,

No 1 — gives 10" at 1½ phonoplex
Shunt off —

No 2 Audion - Three 5" -

We now put audions
Thus



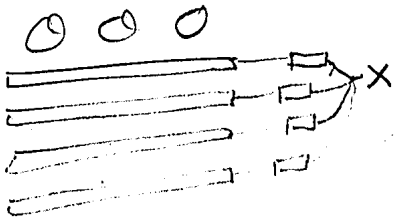
A B are 2 WE phone Coils
1800 ohm running in series
C D are 4 mf of condenser
Each — All to a Cap
Battery running thru
~~Tube~~ Transformer Coils

Cant get anything to work Except seperate audions.

We now connect No 1 audion as plain audion & take everything off glass insulators —
get 2" Ilwaco & Longbeach at 2" but its wooey varies from 1/2 to 2"
Bad zero stick there —

When they lose magnetism
the Milliamp go up

Note 25U has been
losing lost its magnetism
from violent knocks
on holder due to
heavy Currents went
up beyond 100 mil amp
to 1 amp



Connected all the lamp
strips through under
mk Res Ohms - got
6" swing 1½ of Lamplex
Zero not perfectly steady
0 to 1" generally low -
Did now connect the
Ends X to Earth -
no advantage. lead
Zero -
U25 lost magnetism
put in U26

Its ok 2" phonoplex 2"
throw minimum going to 5"
but zero is bad, with &
without the India ink
Res now removed

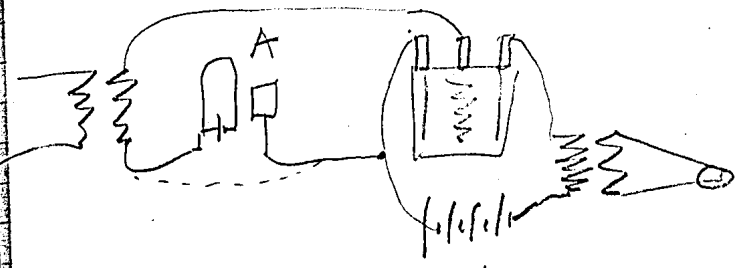
WE now discard all
lead covered wire
use twisted rubber
Ends at both ends
connected & used
as 1 wire — No gain

We now Connect No 1
Audion Input so its
secondary has 1/4 of
the secondaries reduces
the swing from 10"
to 6" but the Zero is
no better in proportion

---

put Mirror ckt right on
secondary - no bulbs
phonoptex 1" away
get 1 inch throw

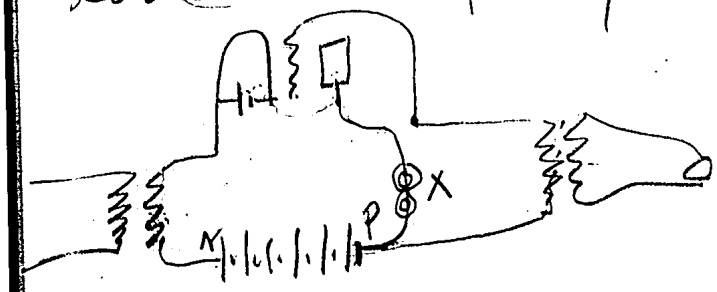
We now try a grid condenser I have made - 20 sheets about, 2 x 4 with grid like Center Electrode



First test is without A Audion lamp which is for purpose of preventing Reverse Current getting there to Condenser.

2nd test is with Audion lamp in acting merely as a valve

Neither tests work only give 1" throw when phonoplex 1/2" away probably Condenser too small Capacity -

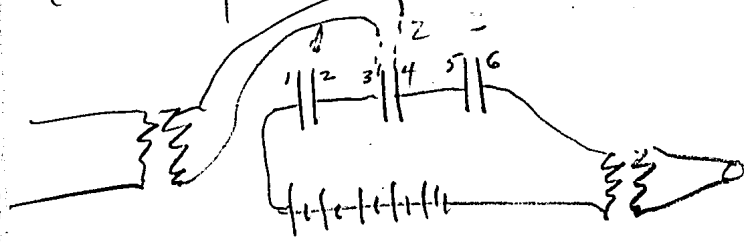


We try this to see what it will do -

Dont work - put 2 choke Coils 1500 ohm each in series in at X

This dont work

Extra Expt



4 mf condensers at 1 2 + 3

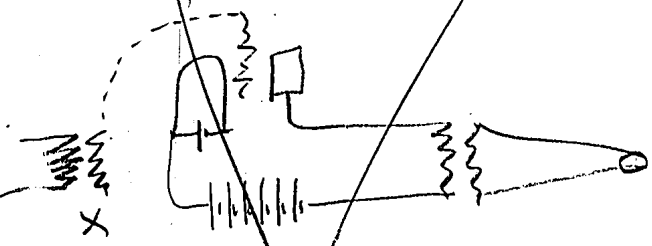
Connected to 3 + 4

nothing

2 to 5 — nothing

None any good

Expts Continued 73



X Coil not connected note zero -

2nd

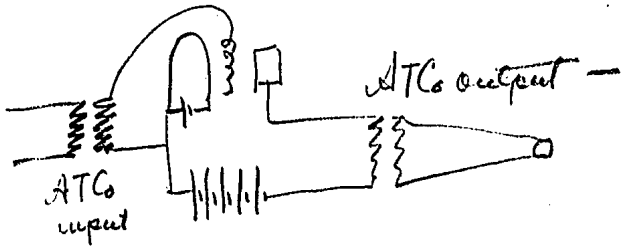
Connect coil as per dotted line — note zero

3

Connect Coil in the
usual way insert

6 cells 1 cell 1 to 5
then 2 3 4 & so on until
10 & note Zero

Hell

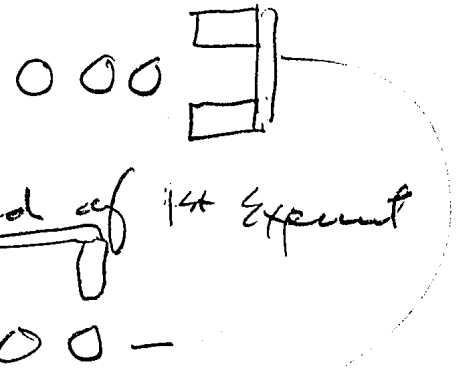


Reg iway

We are going to try a strong Electromagnet besides the 3 bulbs to see if the Magnetic Lines could attract the Electron arc + make it steady -

It makes a good Zero but amplifying power reduced from 10 To 5 inches ! ?

We now put magnet



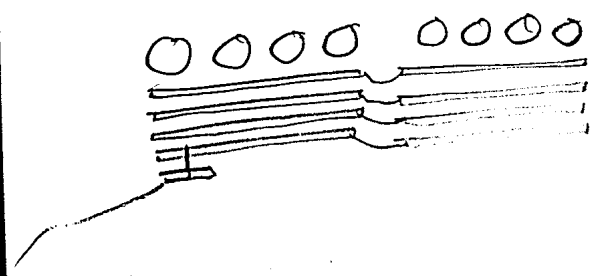
instead of 14th Experiment

This not good Zero
but think it necessary
Multiplying power
2" phonopic 2½ @ 3"
Head - unsteady
but good -

We now try a new Experiment
Instead of using 3
bulbs in Multiple we
use 6

While amplifying power
dont increase after 3rd
bulb is in, it is hoped
that filling in occurred
more than any particular
bulb if Electron are in it
Changes suddenly that
it will be a small
% of the whole

+ thus while the sudden strong spits occur in all lamps at times, they will on account of the number of lamps be reduced in strength & give a large number of weaker ones which will not affect the mirror so much



It's probably not the bulbs but it is static affecting the bulbs - (ie) amplified doubs of static -

The resistance of 7500 ohms per lamp will be reduced by 8 lamps to 937 ohms -

We find that the sudden spots of current caused even with 6 bulbs in multiple - The zero is a little better ~~up~~ with 2" phonaplex but never less than 2" throwing to 3 @ 3½"

Some of our past Experiments on Zero have been Vitiated by bad Contacts on our Turning Drum —
We are now cleaning the wire, bands, & Contact Springs —

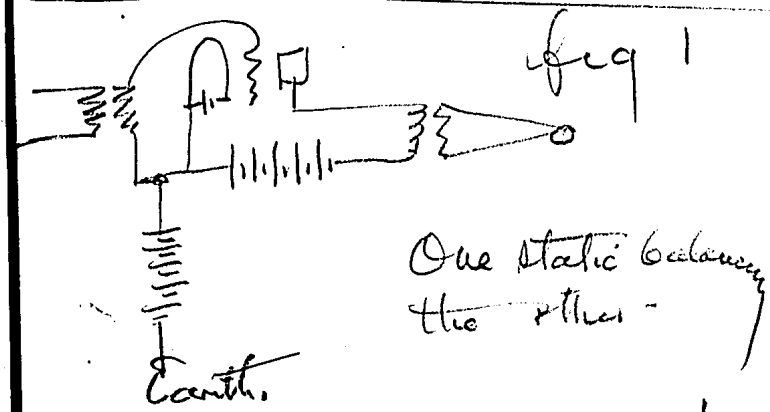


fig 1

One static balancing the other —

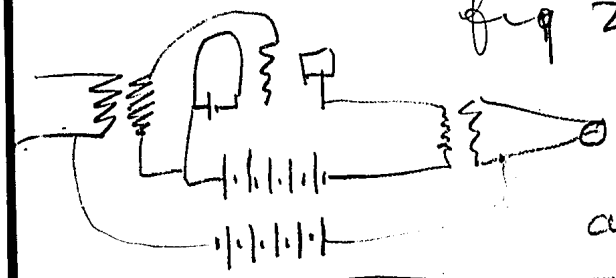
About the same ~~bad~~ waving
Reversed direction - just the same "

fig 2 one direction big relative
at open mirror switch —
Unsteady mirror
Reversed battery - just as bad

No 4 = Unsteady - static when
mirror switch closed
Reversed battery - Wavey
just the same

No 3 -
No good Either way

fig 2 81



also this.

fig 3

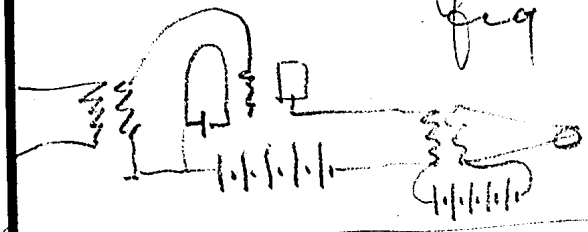
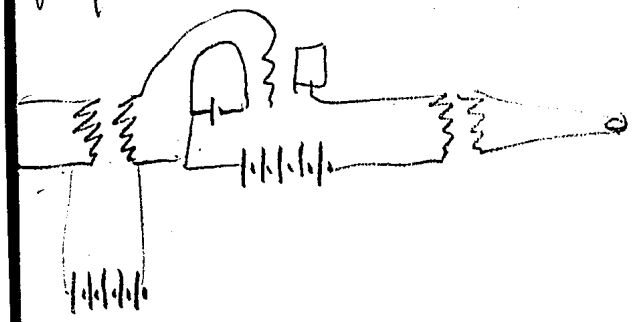


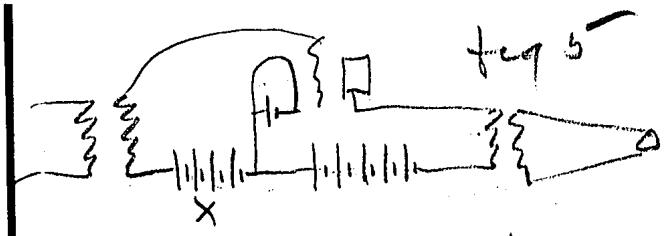
fig 4

fig 4



Always notice that anyone humming etc is always due to some change ~~beyond~~ at output coil of audion, or input coil of 2nd audion —

fig 5



~~battery one way dead zero no sound when phonograph running —~~

~~Reversed X dead zero —~~

~~Took off 1/2 of X battery~~

~~One way nothing~~

Jenny has put batteries in wrong —

fig 5

WE try it over again —

Connected 1 way at X all on nothing | 1/2 on nothing — Reverse nothing — battery off — ok

1 way 1 cell swing ok
2 & so on till 20 when
swing went from 2"
to 1/2" Reversed battery
2 cells brot it to dead
zero — all the times
of Experiments phonoplex
2" away & running
The 2 cells that
killed swing was
positive thru Secondary
to grid —

Past Experiments

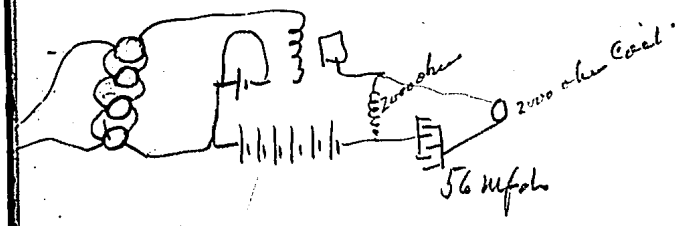
Page 3 book 3

One Audion —

Input-coils 4 Westn Elec
1800 ohms Closed coils —
primaries in series, secondaries
in series
Using Condensers for Output.

2000 ohms from battery to
Bulb plate to carry the Current

Phonoplex 2 1/2" away
1/2" Throw
Phonoplex 3" away 1/8"
Throw at 1" goes off scale



135 V Edmundalander —

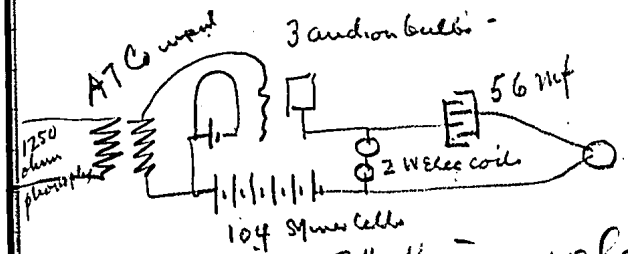
3 bulbs type L

Condensers for output give better Zeros are much higher efficiency + more practical + cheaper —

This at 3" phonoplex is 18 times amplified from direct.

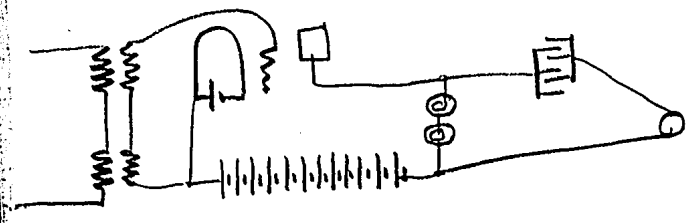
BEST + Most practical yet,

We now Duplicate the Experiment on page 83 — but instead of Weston Electric Coils for input we use Amer T Co input coil & 56 mf Condensers for output + instead of 2000 ohm Res we use 2 W Elec closed induction Coils 1800 ohm each in series



This gives 2" Ilvacco when phonoplex is $2\frac{1}{2}$" away The Zero is pretty good OK for $2\frac{1}{2}$" tried 3" away of phonoplex + got 1" which was very little disturbed + seldom went to Zero, it was unmistakable — 3 bulbs used

We should try this –



Using 2 ATCo Input coils both primaries + secondaries in series + 208 Cells in series –

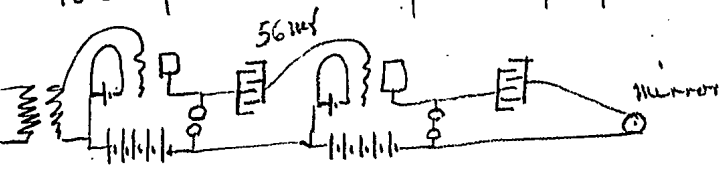
possibly more than 56 Mf of Condensers –

This doubles battery in bulb + doubles Volts on grid –

It may increase the amplification without increasing bad Zero

Possibly 2 input coils should be multiple instead series – + possibly only 1/2 or 104 cells needed

We now once more try 2 audions in series with Condensers to duplicate the single 1 on page 84



ATCo Input Coil – 1250 ohm phonoplex
3 bulbs in each series

Phonoplex 2 1/2" away Nothing

Reversed the filament battery on 2nd audion – Nothing –

Something wrong – probably 2nd Batch of Condensers –

just found 2nd batch of Condensers (Chanted)

2 audions

at 2 1/2 – gives 6" Throw

at 3" gives 2 1/2 inches –

at 3 1/2" phono gives 1 inch with an occasional jump

Zero almost as good as 1 and only 10v

Charges + effect [illegible] should be grounded when [illegible] switch on [illegible] regulating [illegible]

Summerice —

1 Audion —

phonoplex	Deflection
$2\frac{1}{2}$	2"
3"	1"

2 Audions —

phonoplex —

$2\frac{1}{2}$	6"
3	$2\frac{1}{2}$
$3\frac{1}{2}$	1"

The Gain is no where near what it should be
Audions do not amplify in proportion to first deflection
Take the 3" away — there is only $2\frac{1}{2}$ times multiplication —

Whereas if first audion amplified the Original Circuit 10 times, which it certainly does the deflection at 3" to wit 1" would be 10 inches at least

See Diagram page 84½

We will now try this — as it is simpler & we could rewound a single coil to take place of the 2 seperate coils —

3" phonoplex 1½ —— X

We now double up the battery to 208 Cells instead of 104 as with X result, dont improve still 1½ throw & more unsteady — its not more battery

We want think 104 cells is enough
We now double up the Condensers
Does no better state $1\frac{1}{2}$

We now multiple over the
primary coils of the two
Input coils, leaving
secondaries in series
This is not so good
We put them back in
series —
for fear they are not in
right direction we reverse
direction — no first way
was OK now put back

Now we make another Change — We remove the 2 Westinghouse choke Coils & substitute 3600 ohms of plain resistance to see what it does — No good must have Choke Coils — Very unsteady Zero current then & ~~Secondly~~ any throw —

We now put the two coils back with one Extra one all in series — not so good as 2

We now put 2 in series across & then 2 more in series - This makes 4 Choke Coils - Total resistance 1800 ohms thus permitting twice as much Current from the battery to reach the plates of the 3 tubes — as in first Experiment with only 2 —

This is better yet $1\frac{1}{2}$ in 3" phones better Zero -

We now remove 1/2 of the Condensers —

Its not so good only 1" & then Zero out

will shift the acts & put in
the other act to see if
difference in Condensers
no difference
Best to have all the
Condensers on

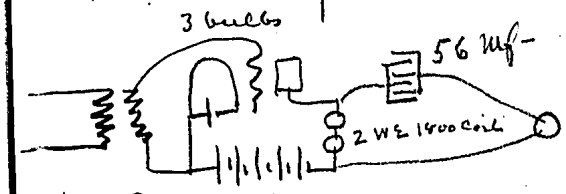
We now remove 1/2
of the battery on grids
leaving 10 of cells on
This is better gives 1 1/2 +
pretty steady —
added the Extra bunch
of Condensers but
its too much makes
it unsteady

We now add 3 more bulbs making 6 bulbs in all —

Been using 4550 ohm
Mirror Coil
#3 AR

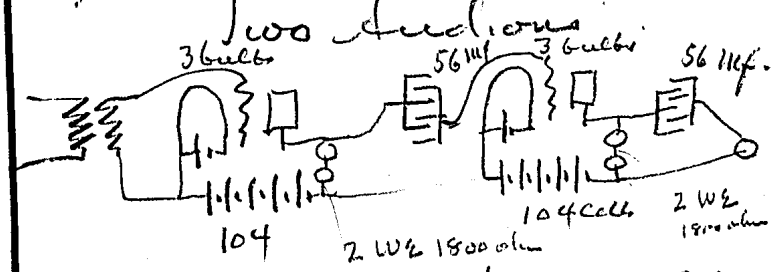
Finale —

Best Single Audion



ATC 104 cells 2" throw at $2\frac{1}{2}$ phonoplex
Input — 1" throw at 3" phono
fairly Constant.

Two audions



6" throw with $2\frac{1}{2}$ phonoplex
$2\frac{1}{2}$ throw with 3" phonoplex
1" throw with $3\frac{1}{2}$" phonoplex

Need for a good Carbon Telefon

Phonaplex ~~without~~ Verum fcq decaphon

Strength of field at a distance of of 1½ throw

1 inch	100 %	amplifier times
1½ "	29.4	3.4
2 "	12.5	8
2½ "	6.4	15.6
3	3.7	27
3½	2.3	43.5
4	1.6	62.5
4½	1.1	91
5	0.8	125 times

at 1" phonaplex get 1½ deflection without audion